Abstract of the Invention

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A Time-Of-Flight mass analyzer includes a multipole ion guide located in the ion flight path between the ion source and the flight tube of the Time-Of-Flight mass analyzer. In one preferred embodiment, a Time-Of-Flight (TOF) mass analyzer is configured such that a multipole ion guide is positioned in the ion path between the ion source and the ion pulsing region of the TOF mass analyzer. The multipole ion guide electronics and the ion guide entrance and exit electrostatic lenses are configured to enable the trapping or passing through of ions delivered from an atmospheric pressure ion source. The ion guide electronics can be set to select the mass to charge (m/z) range of ions which can be successfully transmitted or trapped in the ion guide. More than one set of m/z values can be selected using techniques such as notch filtering with resonant frequency ion ejection of unwanted m/z values. All or a portion of the ions with stable ion guide trajectories in transmission or trapping mode can then undergo Collisional Induced Dissociation (CID) using one of at least three techniques. During the ion fragmentation step the multipole ion guide AC and DC electric potentials are set to transmit or trap all or a portion of the fragment ions produced by the CID process. All or a portion of the parent and fragment ion population are delivered from the multipole ion guide to the pulsing region of Time-OF-Flight mass analyzer for mass analysis. After the first ion fragmentation step, the multipole ion guide AC and DC electric potentials can again be set to select a narrow m/z range to clear the ion guide in trapping mode of all but a selected set of fragment ions. The m/z selection and ion fragmentation step can be repeated a number of times with mass analysis occurring at the end of all the MS/MS^n steps or at various times during the MS/MS^n stepwise process. A technique is

also described where the normally stepwise MS/MS^n analysis function can be merged into a single step, increasing the effective duty cycle. The multipole ion guide used for ion transmission, trapping and fragmentation can reside in one vacuum pumping stage or can extend continuously into more than one vacuum pumping stage.